



Workability and Compressive Strength of Mortar with Manufactured Sand

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Abstract

Sand obtained from river stream is broadly utilized as fine aggregate in manufacturing of ordinary mortar. Because of extraction in abundance characteristic sand has turned into a scare material and it must be protected. Sand obtained from crushing of stone have better particles shape, size and surface textures than natural river sand due to controlled degradation of natural rocks and have very high potential to replace the natural sand in preparation of cement mortar. Present paper investigate the effect of manufactured sand in mortar in terms of workability and compressive strength. To accomplished this manufactured sand was replaced with river sand in mortar for different percentage level at an interval of 10 and investigate the workability and compressive strength for the mix. Results show that manufactured sand can be replaced with river sand for gaining the strength and use a dose of super plasticizer to maintain proper workability at a particular proportion of water cement ratio.

Keywords: Ccompressive strength; Manufactured sand; River sand; Workability.

1. INTRODUCTION

Cement mortar is a composite material commonly used for jointing of bricks, stones, blocks, etc. It consists of binding material as cement, fine aggregate and water. Sand obtained from river stream is broadly utilized as fine aggregate in manufacturing of ordinary mortar. Because of extraction in abundance characteristic sand has turned into a scare material and it must be protected. The only way to protect environment and continued construction is to search alternate materials which can be partially or fully replaced naturally available material, manufactured sand may be one of them. This is obtained from crushing of stone chips in crushing plant. Crushed sand performed better than natural sand as the property of crushed sand is better than the natural sand (Rameshwar et al 2017). Stone dust can be used in place of fine aggregate upto 60 percent for enhancing the strength of concrete (Suman et al 2015). The present study aimed to utilizing manufactured sand in place of natural river sand as partially or fully in mortar. For that an experimental programme was carried out to study the suitability and potential use of manufactured sand as a replacement of river sand in mortar. To accomplish this specimen were cast for different replacement level at an interval of 10 percent to determine workability and compressive strength of mortar at different level of river sand with manufactured sand. The percentage of manufactured sand was gradually increased in mortar and investigates its effect in sense of workability and compressive strength. The study shows that compressive strength of mortar made using manufactured sand as river sand

replacement having greater magnitude in comparison of mortar with river sand whereas the workability of mortar was decreased rapidly with increased amount of manufactured sand in mortar. It may be due to lack of surface moisture and rough surface texture of manufactured sand.

2. MATERIALS & METHODS

2.1 Cement

Portland Pozzolana Cement (fly ash based) confirming to IS 1489 (Part 1) - 1991 brand name Prism was used in this study. The properties of cement were as shown in table 1.

Table1. Physical properties of cement

S. No.	Properties	Findings
1.	Fineness	6%
2.	Consistency	32 %
3.	Initial setting time	215
4.	Final setting time	320
5.	Specific gravity	2.8
6.	Soundness	5 mm

2.2 Fine Aggregate

Locally available river sand in Prayagraj confirming to IS 383-1970, zone III was used in the study. It was completely passed through 4.75 mm IS sieve. Physical properties of fine aggregate are shown in table 2.

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Table 2. Physical properties of fine aggregates

S.No.	Properties	Natural Sand	Manufactured Sand
1.	Specific gravity	2.60	2.62
2.	Moisture content	0.3%	0.2%
3.	Fineness modulus	2.9	3.42

2.3 Manufactured Sand

Manufactured sand was obtained by the grinding of locally available stone chips and sieved with different size of sieve for maintain same grade as fine aggregate confirming to IS 383- 1970, zone III. Physical properties of manufactured sand are shown in table 2.

2.4 Water

Potable water was used for mortar mixing having pH 8.4 and total dissolve solids 450 mg/l. Mortar mix 1:5 (1 part of cement and 5 part of sand in volume) with water cement ratio 0.6 is used as bench mark for this investigation. The grading of river sand and manufactured sand were approximate equal and confirming same zone according to IS 383-1970. Total 56 specimens of size 70.6 mm X 70.6 mm X 70.6 mm were casted during the study with different percentage of manufactured sand in place of river sand in mortar. The percentage of manufactured sand in mortar increased gradually from 0 to 100 percent in an interval of 10 percent. After mortar mix the workability of mix was measured by flow table test and desired specimens were casted. On other day the specimens were demoulded and water cured for 28 days. The water cured specimens were tested for compressive strength at 7 days and 28 days.

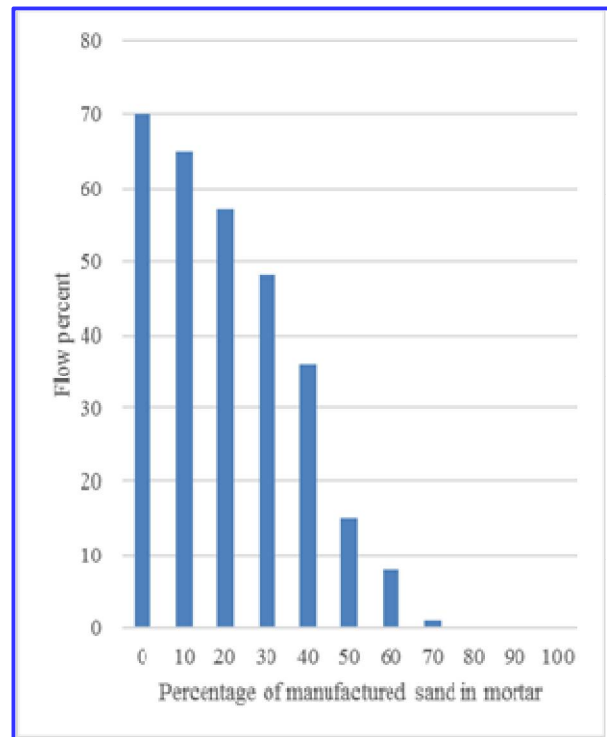
3. RESULTS & DISCUSSION

3.1 Workability

The workability of fresh mortar mix was measured by flow table test. The flow table test indicates the flowing behavior of mix in terms of resulting increase in average base diameter of the mortar mass and expressed as a percentage of the original base diameter. The flow percent for different mix are shown in table 3 and graphical view in figure 1. Result shows that on increment in percentage of manufactured sand in mortar decrement in flow percent i.e., decrement in workability gradually with respect to mortar with natural sand. Mortar with 70 percent manufactured sand and above did not show any noticeable flow, only distortion in shape was noted.

Table 3. Workability of mortar mix

S.No.	Percentage of manufactured sand in mortar	Flow percent
1.	0	70
2.	10	65
3.	20	57
4.	30	48
5.	40	36
6.	50	15
7.	60	8
8.	70	1
9.	80	0
10.	90	0
11.	100	0

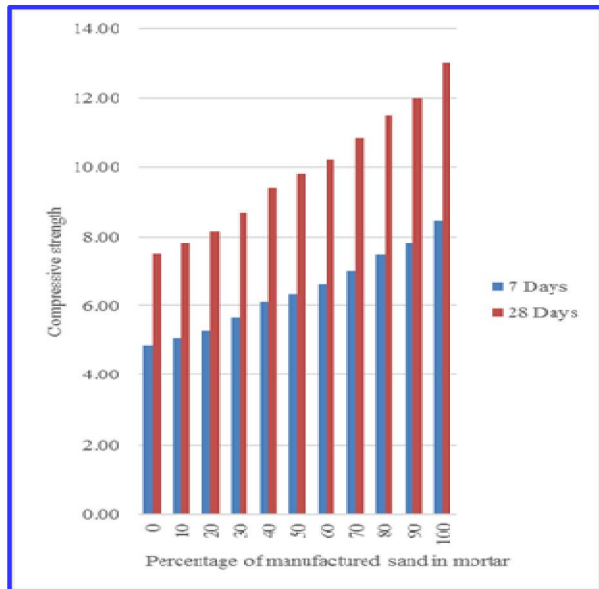
**Fig. 1: Workability of mortar mix**

3.2 Compressive strength

Average compressive strength of three specimen sample was used for strength calculation. The average compressive strength of mortar mix for 7th days and 28th days were tested and tabulated in table 4 and graphical view shown in figure 2. Result shows that the compressive strength of specimens with manufactured sand is always greater than the mortar with natural sand. Maximum strength obtained at 100 percent replacement level and the strength varied gradually from 0 to 100 percent with maximum variation of 73.33 percent in respect to mortar with river sand.

Table 4. Compressive strength of mortar mix

S.No.	Percentage of manufactured sand in mortar	Compressive Strength of mortar	
		7 Days	28 Days
1.	0	4.88	7.50
2.	10	5.07	7.80
3.	20	5.30	8.15
4.	30	5.66	8.70
5.	40	6.11	9.40
6.	50	6.37	9.80
7.	60	6.63	10.20
8.	70	7.02	10.80
9.	80	7.48	11.50
10.	90	7.80	12.02
11.	100	8.45	13.00

**Fig. 2: Compressive strength of mortar mix**

4. CONCLUSION

Based on experimental investigations following points can be concluded.

- The workability of mortar decreases rapidly with partial replacement of natural sand with manufactured sand.
- The strength of mortar made using manufactured sand is high at all replacement level in comparison of natural sand.
- The mortar with manufactured sand can be used in masonry work with high water cement ratio.
- The workability of mix can be managed by using a dose of superplasticizer in mix.

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